Reviewer 3

We thank the reviewer for his or her comments, and we respond to them in bold, inline below.

Woo et al. presents a simple version of the GAMMA model, with a main focus on aerosol uptake of IEPOX and glyoxal. This is a short paper, and the work does not present enough new knowledge, at its present form. In the GAMMA paper (McNeill et al., 2012), the authors have already identified the major contribution pathways to aaSOA formation in their model (the uptake of glyoxal and IEPOX). This work simply extracts the relevant reactions of these two pathways and produces a simplified version of GAMMA. The authors then find that this simpleGAMMA behaves very much similar to GAMMA, but with a lower computation cost. While I agree with most comments from the other two reviewers, I have a few more comments:

1. Sensitivity to aqueous OH. As one of the two reviewers pointed out, aqueous OH can be largely enhanced by Fenton reaction. What is the sensitivity of modeled SOA to aqueous OH?

As stated in response to Reviewer 1, first, we note that the McNeill et al. (2012) study and the test simulations presented in this work were for ammonium sulfate aerosols with no significant transition metal ion content, and therefore Fenton chemistry would not be active. However, following up on the Reviewers' suggestions, we have implemented transition metal ion chemistry for iron, copper and manganese, including Fenton reactions, into GAMMA following CAPRAM 3.0 in order to test the effect of these mechanisms on OH concentrations and therefore SOA chemistry. Using the test conditions of CAPRAM 3.0 (initial concentrations of $[Fe^{+3}]_0$ = 5e-6 M, $[Cu^{+}]_0$ = $[Mn^{3+}]_0$=2.5e-7 M for urban conditions, $[Fe^{+3}]_0$ = 5e-7 M, $[Cu^{+}]_0$ = $[Mn^{3+}]_0$=2.5e-8 M for remote conditions) and other conditions as described in McNeill et al. (2012), we find that the aqueous aerosol SOA chemistry is still OH-limited and the predicted product distributions do not change. Despite the lack of observed effect, we expect this may actually be an overestimate of the impact of TMI chemistry because ambient studies have indicated that iron-containing minerals are not homogenously distributed across the aerosol population (Moffet et al., 2012). This will be the subject of a future study.

The issue of additional unknown sources of OH was mentioned in the discussion session of the original manuscript, but we have expanded this.

2. Aqueous diffusion. According to Schwartz (1986), aqueous diffusion may play an important role in the aqueous system. Have this been considered in the GAMMA model?

Aqueous diffusion is not accounted for in GAMMA or simpleGAMMA, that is, Henry's Law equilibration is assumed to occur instantaneously and no spatial concentration gradients within the particle are considered. This likely leads to an overestimate of OH chemistry when this very fast-reacting species is taken up from the gas phase. However, since we have found aqueous aerosol chemistry to be OH-limited and aqueous phase photochemistry does not dominate aaSOA formation, inclusion of aqueous phase diffusion limitations in this calculation would not change our results or the formulation of simpleGAMMA. Aqueous phase diffusion may also be important for relatively large droplets. We have made note of this in the text.

3. Correction for ionic strength. If this is a highly concentrated aqueous solution, the aqueous kinetics should be corrected for the ionic strength. Have this been considered in this model?

As stated in the GAMMA paper (McNeill et al. (2012)), "…*with the exception of the rate constant in the Eddingsaas (2010) mechanism for SOA formation from IEPOX, the influence of ionic strength on the reaction rates is not considered in the current version of GAMMA due to a lack of necessary thermodynamic data.*" As stated by Herrmann et al. (*Chemosphere* 2003, *52*, 485-502) in reference to their model, CAPRAM, "*At the current state the influence of ionic strength effects on the kinetic behaviour, i.e. the consideration of activity coefficients, or, alternatively, kinetic salt effects are not included in these model studies due to very sparse thermodynamic data especially for the ions and radical ions*." The IEPOX reaction mentioned in the aforementioned passage from McNeill et al. (2012) is the only aqueous reaction explicitly considered in simpleGAMMA. The effect of ionic strength on the Henry's Law constants of glyoxal and IEPOX is accounted for through the use of experimentally determined H* values for uptake to deliquesced aerosols.

It seems to make more sense if authors can include an implementation of simpleGAMMA into a 3-D model, and show some results from that. That will justify its publication in GMD. The current content seems a little bit thin, in my opinion. But I will leave this to the editor to decide.

The implementation of simpleGAMMA into several different 3D models is currently underway (see, for one example, Jathar et al. 2014). This manuscript provides the necessary description of simpleGAMMA to form the foundation for those studies. The demonstration of simpleGAMMA's application to modeling ambient measurement data can be found in Budisulistiorini et al. (2015).